IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF OREGON

NORTHWEST ENVIRONMENTAL DEFENSE CENTER, WILDEARTH GUARDIANS, and NATIVE FISH SOCIETY,

Plaintiffs,

v.

UNITED STATES ARMY CORPS OF ENGINEERS and NATIONAL MARINE FISHERIES SERVICE,

Defendants.

CITY OF SALEM and MARION COUNTY,

Intervenor-Defendants.

No. 3:18-cv-00437-HZ

ORDER

HERNÁNDEZ, District Judge:

Before the Court is the Expert Panel's proposed implementation plans for the Green Peter Dam fall fish passage (injunction action 12(b)) and the determination whether structural improvements/modifications need to be made to Cougar Dam's regulating outlets (injunction action 15(b)). No objections to the Panel's proposals have been raised. Having considered the

Expert Panel's implementation plan, the Court amends Interim Injunction actions 12(b) and 15(b) as follows:

(12) After adult outplanting above Green Peter Dam begins, the Corps SHALL carry out juvenile downstream passage measures at Green Peter Dam.

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(b) Beginning fall 2022, the Corps SHALL carry out fall fish-passage operations at Green Peter Dam as specified in the Expert Panel's Green Peter Dam Fall Fish Passage Implementation Plan.[1]

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(15) Beginning in 2022, the Corps SHALL conduct spring passage measures at Cougar Dam

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(b) The Corps SHALL make modifications to Cougar Dam's regulating outlets to provide safer fish passage without generating excess TDG as specified in the Expert Panel's Cougar Regulating Outlet Modification Recommendation.[2]

IT IS SO ORDERED

DATED: July 12, 2022.

Marco Hernández

MARCO A. HERNÁNDEZ
United States District Judge

[1] Included as Attachment 1 to this Order.
[2] Included as Attachment 2 to this Order.

ATTACHMENT 1

Green Peter Dam Fall Downstream Fish Passage Injunction Measure 2022-04-20

Description/Intent

On September 1, 2021, the U.S. District Court for the District of Oregon issued a final Interim Injunction Order that directs the Corps to implement specified operations intended to improve conditions for fish passage and water quality in the Willamette Valley Project (WVP) to avoid irreparable harm to Endangered Species Act (ESA) - listed salmonids during the interim period until the completion of the reinitiated ESA consultation. These measures must be carried out "to the greatest extent practicable under existing hydrologic conditions and necessary flood control operations" while making "every effort to comply with the various water quality standards governing WVP."

The Court assigned an Expert Panel comprised of two of Plaintiffs' experts, two NMFS biologists, two Corps employees, and two "ad hoc" Federal experts to define the implementation and research, monitoring, and evaluation (RM&E) plans of specific measures. Among the measures adopted by the court is the provision of juvenile passage through Green Peter Reservoir and Dam following reintroduction of adult Chinook salmon to spawning habitats upstream of the reservoir. The Expert Panel was assigned the task of developing spring and fall passage plans that prioritize volitional passage. This is the plan for fall juvenile fish passage operations.

When developing and planning for the implementation of any operational change, multiple factors must be considered.

- First, what is/are the biological objective(s) or goal(s) being sought and how can these objectives best be achieved?
- Second, what are the constraints or factors that need to be considered?
- And third, what additional information should be considered when shaping the operation?

Biological Goal

The overall goal is to establish a self-sustaining population of spring Chinook salmon upstream of Green Peter Dam. The goal of this drawdown operation measure is to provide volitional downstream passage and survival for juvenile spring Chinook salmon and steelhead through Green Peter Reservoir and past Green Peter Dam in the fall with high passage efficiency and high immediate and long-term survival. The target fish for the fall operations would be salmon fry and subyearlings that entered the reservoir in the previous winter–spring and reared through summer in the reservoir, and subyearlings that enter the reservoir in summer and fall. The number and proportion of salmon fry that remain and rear in the reservoir will depend on the passage effectiveness of spring operations under Measure 12a. The number and proportion of stream-reared summer and fall migrants after adult Chinook salmon are outplanted will be determined through RM&E activities under this measure (traps upstream of reservoir) and Measure 12a (traps upstream of reservoir and life history sampling in streams upstream of the reservoir).

Through biological studies (or RM&E) over the last several years, regional biologists have learned that juvenile Chinook salmon and winter steelhead generally pass the Willamette dams when provided with a near-surface route. They also tend to pass mostly at night and survive in greater numbers when

passed through a non-turbine outlet. Given this information, the following fall downstream fish passage operation is proposed.

Implementation Plan

Prior to the implementation of the Green Peter fall drawdown downstream fish passage measure, the installation of a backup power source is required to ensure power reliability to the dam in the event that the primary power source during the drawdown (the grid) is unavailable. This backup power source will be supplied by back-up diesel generators. Installation of the backup generators should be prioritized in 2022; however, if this is not attainable, then installation will occur no later than the summer of 2023.

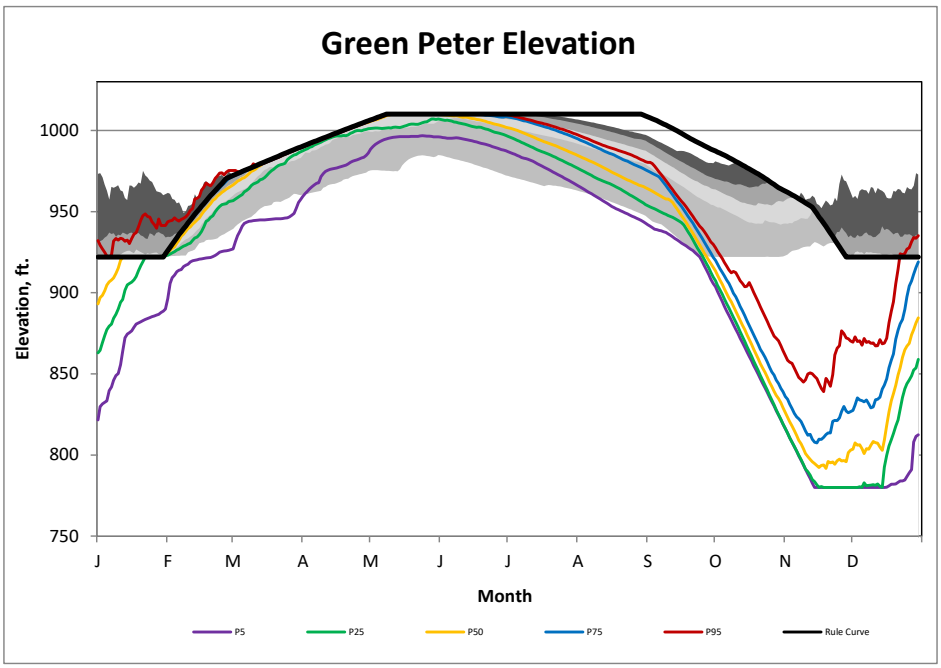
Once back-up power is installed, Green Peter Reservoir will be drawn down with a target elevation of 780 ft. by early to mid-November. The date of initiating drawdown will be based on real-time conditions and hydrologic predictions with the aim of a 75% likelihood of achieving El 780 ft. by November 15 while meeting other project constraints.

The Corps' Hydrologic Engineering Center (HEC) Reservoir Simulation Model (ResSim) model was used to simulate reservoir operations at Green Peter Dam for this measure and provide a cursory look at the timing of drawdown and the discharges potentially required to achieve El 780 ft. by November 15. Based on model results (Figure 1) the initiation of drawdown is expected to occur between early July and early August, so as to achieve the targeted elevation by mid-November. Inter-seasonable adjustments will be necessary, however and modeling results should be considered a general guideline. Discharge during drawdown will likely range between 3,000 and 4,000 cfs, except as may be required by flood risk management operations or during Chinook spawning. From September through mid-October, Green Peter and Foster Dam outflows will be managed to maintain flows between 1,500 and 3,000 cfs in the South Santiam River downstream from Foster Dam to protect Chinook spawning, to the extent possible.

The targeted elevation of 780 ft. is approximately 35 feet over the regulating outlets (ROs) at Green Peter Dam. As soon as the reservoir is drawn down below minimum power pool (El. El. 887 ft.), the Green Peter powerhouse will cease operation and all water will be discharged through the ROs. The reservoir will be held at or near El. 780 ft. until 15-December. On 16-December, refill will begin and continue, according to rule curve for the spring spill operation.

Adult fish will be outplanted above Green Peter Dam in the spring/summer 2022 (*see* ECF 228-1, Green Peter Outplanting Plan), and naturally produced juveniles will begin to pass the dam during drawdowns in 2023. If available, juvenile Chinook salmon raised for experimental purposes (surrogate fish) will be released at the head of the reservoir to evaluate reservoir and dam passage behaviors, and survival under the drawdown operation. Starting in 2023, the timing and size of naturally produced juvenile fish entering or residing in the reservoir will be compared to the timing and size of fish passing the dam as an additional evaluation of the operation.

Based on initial ResSim modeling results, when refilling Green Peter, outflows could be very low, if not zero (Figure 1). To facilitate spring spill (Injunction Measure 12a), refill timing may be adjusted. Once El 887 ft. is achieved during refill, powerhouse operation would resume. Throughout refill operation, discharges from Green Peter and Foster dams will be managed to meet South Santiam River flow targets.



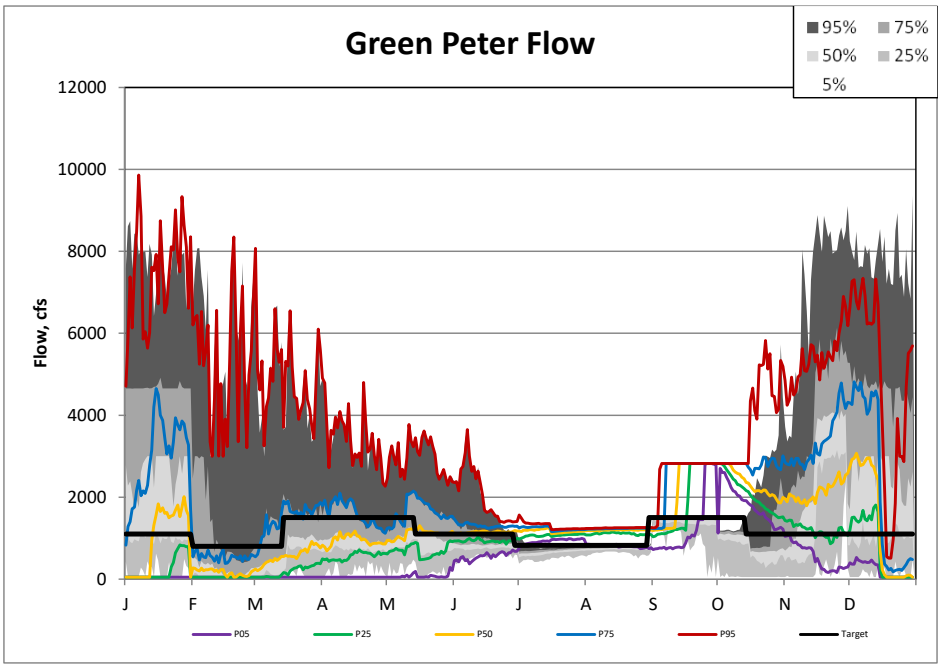


Figure 1. ResSim Results of the Green Peter Spring and Fall Fish Passage Measure

Constraints and Considerations

This plan considers both the constraints that must not be violated, as well as other considerations such as current hydrologic conditions, etc. While implementing the fall passage operation at Green Peter Dam, the following constraints must be adhered to at all times:

a. In general, non-turbine outlet operations are known to produce total dissolved gas (TDG) in exceedance of 110%. There is a lack of data to predict TDG production from Green Peter spill operations. Therefore, a TDG instrument will be installed downstream of the dam to monitor TDG conditions during fish passage operations.
b. RO operation will prioritize the south ROs to avoid exacerbating current erosion concerns in the stilling basin.
c. The Corps' flood control mission is prioritized over all other actions and at no time will human health or safety be jeopardized during the implementation of this measure.
d. This measure will be implemented once back-up diesel generators have been installed on Green Peter Dam (see Dam Safety section).
    a. The current Green Peter emergency diesel generator (EDG) cannot be used at elevations less than El. 858 ft and the turbines cannot be used at elevations less than El. 887 ft. (min power pool). This leaves the Corps with only one power source to operate the gates (pulling power off the grid) and no redundancy (back-up power) in the event that power source is unavailable. This is in violation with safety protocols.
e. Minimum gate openings will be observed at all times to avoid gate vibrations.

In addition to the constraints, the following considerations were used to develop the Green Peter fall passage operations implementation plan:

a. Detailed investigation of fish passage through the ROs at Green Peter Dam has not been conducted but experience shows that larger gate openings generally provide safer passage. This will be taken into consideration.
b. Any construction or maintenance activities scheduled or planned during the time of this operation will be vetted through Water Management.

Biological Monitoring

The goal of the RM&E is to learn as much as possible from this downstream fish passage operation to inform the success of this operation or any changes/adjustments to the operation in future years. A primary objective of the fall drawdown at Green Peter Dam is to provide safe conditions for volitional passage of juvenile Chinook, and, in addition, potentially emigrating winter steelhead juveniles if steelhead are reintroduced. Due to very low UWR winter steelhead abundance and the risk of failure, only UWR Chinook salmon will be reintroduced at this time and this monitoring plan is focused on them. The plan will be modified to include winter steelhead if they are reintroduced to areas upstream of Green Peter Dam.

This biological monitoring plan provides guidance for the initial phases of the fall drawdown. Surrogate juvenile hatchery Chinook salmon would be used to provide adequate sample sizes for tests to evaluate passage operation conditions. Knowledge acquired from test releases and from studies of naturally produced fish (migration timing, reservoir behavior, etc.), will be used to modify dam operations and/or

RM&E as needed. The metrics of interest during the fall drawdown include passage timing through the reservoir, forebay behavior, dam passage rates, and passage survival.

Ideally, RM&E relative to passage at Green Peter Dam would also include monitoring subsequent passage at Foster Dam and long-term survival in the South Santiam River downstream of Foster Dam. However, the capability of evaluating passage operations at Green Peter Dam is limited to passage and survival immediately below Green Peter Dam because monitoring infrastructure is inadequate or nonexistent at Foster Dam or in the South Santiam River downstream of the dam; e.g., no means to sample juvenile fish below Foster spillway and, no PIT tag detection capabilities throughout the river. Therefore, development of monitoring infrastructure has been identified as a high priority in the long-term RM&E plan (ECF 240-1 at 26–27) so that the effectiveness of operations at Green Peter and Foster dams can be fully evaluated.

Research, Monitoring and Evaluation

RM&E for the Green Peter fall drawdown downstream passage measure is subject to the conditions recognized in the Expert Panel's long-term RM&E plan (ECF 240-1 at 2).

The passage effectiveness of fall drawdown operations at Green Peter Dam will be evaluated by releasing surrogate hatchery Chinook salmon and by monitoring the migration and behavior of naturally produced juvenile salmon (starting in 2023) [1]. Groups of juvenile Chinook salmon (surrogates or other hatchery fish) would be released at the head of the reservoir to estimate travel time through the reservoir and estimate dam passage survival relative to discharge and gate openings. Tagging studies of naturally produced juvenile salmon from outplanted adults along with studies of migratory timing and behavior (including reservoir behavior) would supplement the studies with surrogate or hatchery fish. Studies during the first years of the drawdown operation will provide experience with the experimental methods and equipment being used, potentially identifying measures to improve the effectiveness of subsequent RM&E at the project.

1. Passage timing
    a. Operate rotary screw traps upstream of the reservoir and downstream of the dam.
    b. Estimate the number of juvenile salmon caught in each trap.
        i. Determine trap efficiencies at least once a month under a range of flows expected to occur during the measure.
        ii. Use wild subyearlings captured in traps to estimate efficiency. If too few fish are caught, then efficiency could be estimated with juvenile hatchery salmon although their behavior and size may introduce bias in the estimates (hatchery fish used for trap efficiency would be in addition to those needed for dam passage studies).
        iii. Release groups of dead juvenile hatchery salmon upstream of traps to estimate catch rate of mortalities. Release location would depend on the placement of the trap relative to potential dam passage routes (powerhouse or RO).
        iv. Sum weekly estimates to derive total abundance during peak migration.

[1] Note that if drawdown occurs in 2022 (pending installation of backup power), evaluation would be only with surrogate fish test releases.

v. Investigate the potential to develop an abundance index using numbers of fish caught, size, and flow to supplement estimates derived from trap efficiencies, to provide an approximate index to determine timing, and to provide a potential method for approximating abundance during periods of relatively low migration.
vi. Compare abundance of fish entering the reservoir and abundance leaving.
vii. Compare entry timing and passage abundance among years.

c. PIT tag all subyearling salmon (≥65 mm) caught in the rotary screw trap upstream of the reservoir beginning in July to measure passage timing at the dam (and to provide information on passage rates and passage survival).
d. Compare passage timing at dam of PIT-tagged fall migrants relative to time and size when they entered the reservoir or were captured in the reservoir (reservoir sampling is proposed in RM&E of Measure 12a, *see* ECF 240-1 at 15). Analyze peak timing of fall migrants relative to the timing of the drawdown and subsequent passage at the dam.

2. Passage size and condition: estimate size and condition for juvenile Chinook salmon passing Green Peter Dam during drawdown.
   a. Measure (fork length) of each fish caught in upstream and downstream traps or a randomized sample of fish throughout outmigration period to provide length frequency of outmigrants (all PIT-tagged fish should be measured). The purpose of this metric is to provide information about the life history of the juvenile salmon passing the dam. Collect and catalogue scales of salmon migrants to provide reference sample for stream-reared juvenile salmon.
   b. Compare size of fish caught in upstream and downstream traps.
   c. Record condition of captured fish outmigrating from the reservoir including degree of de-scaling, injuries, degree of copepod infestation, etc. *See* **Additional Information** for more sampling details.
   d. When fish are available, hold a sample of juvenile salmon caught in the trap every week to directly assess delayed mortality (aim for 30–50 fish per week); note that this direct measure of delayed mortality supplements assessments through tagging and downstream sampling. Fish for the test could be held at South Santiam Hatchery or Foster adult trap facility and would be monitored and recorded for 24–48 hours. *See* **Additional Information** for more sampling details.
3. Passage rate and survival
   a. Estimate passage rate and survival of fish with PIT tags (1c) and compare results among years when data are available and to results from controlled test releases.
   b. Tag and release experimental groups of surrogate fish or juvenile hatchery salmon upstream and downstream of dam. An example approach is presented below; final numbers will be developed when a study plan is written and will depend on availability of surrogate fish and other juvenile hatchery salmon.
      i. Release 2,000 PIT-tagged surrogate salmon at the head of the reservoir in late September before or at the start of the final phase of the drawdown. Groups may be released in both the Quartzville Creek and Middle Santiam arms of the reservoir, with priority for Middle Santiam. Release of test fish in September may be postponed if risk of predation jeopardizes the study based on best

available information or results of reservoir study conducted under Measure 12a (ECF 140-1 at 5).

ii. Release 2,000 PIT-tagged surrogate salmon at the head of the reservoir in October prior to a reservoir level of 887 ft. when all or most of the discharge would be through the RO. Groups may be released in both the Quartzville and Middle Santiam arms, with priority for Middle Santiam. A group of 1,000 PIT-tagged juvenile salmon would be released downstream of Green Peter Dam (numbers will be adjusted based on surrogate fish availability).

iii. Supplement releases of surrogate groups above with releases of PIT-tagged juvenile hatchery fish as available:

1. 3,000 at head of reservoir prior to drawdown (late September; but *see* caveats in 3.b.i.).
2. 3,000 each in Quartzville and Middle Santiam arms in October prior to reaching 887 ft.
3. 3,000 downstream of dam in October at or near the same date as above (3.b.iii.2).

iv. Supplement releases of PIT-tagged salmon with release of active-tagged surrogate or juvenile hatchery fish (if available) in head of reservoir and/or other reservoir locations. Active tagged fish could be double-tagged with PIT tags. Release timing would be similar to that of PIT-tagged groups of 3.b.i–iii.

4. Outplant success and origin of juvenile salmon.
   a. Collect tissue samples of juvenile salmon collected in trap(s) upstream of the reservoir.
   b. Analyze samples to determine parentage of juveniles (wild/hatchery, outplant time and location).
   c. Collect tissue samples on all *O. mykiss* in upstream and downstream traps for future genetic analysis to determine potential genetic connection to present winter steelhead population in South Santiam.
5. Estimate overall dam passage survival of juvenile Chinook salmon passing Green Peter Dam.
6. Estimate reach survival of PIT-tagged fish following passage at Green Peter Dam downstream to Foster and Lebanon dams (pending installation of PIT tag antennas; *see* ECF 240-1 at 26–27), and to Willamette Falls. Other reach survivals may be possible if additional PIT tag detection is implemented such as hydrofoil arrays or modular flexible arrays.
7. Estimate reach survival of active-tagged fish (if released in reservoir) after passage at Green Peter Dam by deploying receiver arrays in Foster Reservoir and downstream of Foster Dam.
8. Study results will be presented in the following Spring status reports to provide adequate time to assess results and plan the drawdown operations in subsequent years.
9. In addition, all studies will be presented in detailed and timely reports of methods, results, and discussion with comprehensive appendices of data and analyses details. Reports will be posted where they are available to the public.

Water Quality Monitoring and Modeling

This deep draft operation will likely affect water temperatures and TDG concentrations downstream from Green Peter Dam.

Water Temperature

The U.S. Geological Survey has conducted extensive water temperature modeling within and downstream of Green Peter and Foster dams under a range of alternative dam operations (Sullivan and Rounds, 2021). However, none of the scenarios modeled closely resemble the deep drawdown prescribed herein and all included continued Green Peter powerhouse operation. Nevertheless, this model is useful, and the Corps will work with the USGS to analyze the temperature impacts from this deep drawdown operation through modeling.

A focus of water temperature modeling is to inform reservoir management efforts to meet temperature targets in the South Santiam downstream from Foster Dam. Avoiding the higher than natural water temperatures that typically occur during Chinook salmon incubation (October through December) is a key water temperature objective.

Under this operation, the spillway will likely come out of service earlier than normal during the summer (Figure 1), meaning more of the warm surface water will be stored rather than being passed downstream. During the early fall, once the reservoir water surface elevation falls below the spillway crest (968.7 ft) all or most discharge would occur through the powerhouse with penstock inverts (El 812 ft) 150 feet deeper, capturing cooler water in the stratified reservoir. When El 887 ft is reached in early to mid October, powerhouse operation would cease and all discharge will be through the ROs until refill returns the reservoir to El 887 ft. The RO inverts are located about 140 feet deeper yet and while the reservoir remains strongly stratified, they have an opportunity to provide the coolest water available at the project. Once reservoir temperature stratification breaks down, typically late fall, all outlets would provide similar water temperatures. These isothermic conditions may occur earlier than normal due to the deep draft.

These sudden changes in outlet depth during the drawdown may cause abrupt changes in Green Peter discharge water temperatures, however, modeling has shown that rapid changes in Green Peter discharge water temperature are smoothed by passing through Foster Reservoir (ibid). Green Peter discharge could dominate flows passing Foster Dam during the drawdown period. The earlier end to spillway operation may reduce summer water temperatures downstream from Foster Dam and the extended release of cooler water provided by this measure during the fall could improve compliance with water temperature targets, potentially improving Chinook salmon reproductive success. These effects will be evaluated during the spawning and incubation season by the Flow Management and Water Quality Team.

To evaluate these effects, the Corps will use water temperature data collected at existing USGS station no. 14186200 in the Middle Santiam River downstream from Green Peter Dam and at USGS station no. 14187200 in the South Santiam River downstream from Foster Dam, and the modeled outcomes of the deep drawdown under prior operations to evaluate the effect of the operation on South Santiam River water temperatures downstream from Foster Dam and compliance with existing temperature targets as compared to prior system operations. Any evaluation completed by the USGS, NMFS, or Corps will be presented in their status reports.

TDG

Spilling water through the ROs generates elevated TDG downstream. Under this operation, from the date during drawdown that the reservoir water surface elevation reaches El 887 ft. (early to mid October) through the date that elevation is reached during refill (January) all Green Peter discharge will occur through the ROs. This means that a consistent stream of elevated TDG is likely to enter Foster Reservoir throughout this period where concentrations will decline somewhat due to off-gassing and dilution in the reservoir. This increase in TDG may affect fish in Foster Reservoir and the South Santiam River downstream from Foster Dam. These potential adverse effects will also be evaluated.

To evaluate potential fish harm from elevated TDG, the Corps and NMFS will use TDG data collected at a new temporary monitor located in the Middle Santiam River downstream from Green Peter Dam and at USGS station no. 14187200 in the South Santiam River downstream from Foster Dam and will present these results in their status report.

Dam Safety

During the fall drawdown for fish passage, no hydropower, including station service power, will be generated at Green Peter Dam once the reservoir is drafted below El. 887 ft. In the event there is no power to the dam or powerhouse, there is no control over the outlet works or the drainage pumps that prevent flooding in the powerhouse and dam.

To supply power to the dam during this operation, electricity will be pulled from the grid to power the regulating outlets and auxiliary systems as much as possible. In addition, a backup power source is required to ensure redundancy in the event that the primary power source is unavailable and will be supplied by back-up diesel generators. Although the dam has an emergency backup diesel generator, the cooling water supply is located about 100 ft above the targeted elevation for this fall drawdown, so the current generator will not be useable. This generator is also undersized for this project and is not reliable at remote start. Therefore, a temporary diesel generator will be installed at the powerhouse to supply backup to the line. System design, procurement and installation of this back-up diesel generator will take time, but the Corps is confident that this work can be accomplished by no later than the summer of 2023, with the aim of installation in 2022 if possible.

Also, because of previously identified issues with north side of Spillway/RO stilling basin, priority usage of the south (#2) RO gate is recommended. Under high flow events, spreading spill is acceptable to Dam Safety, but to the extent possible avoid use of the north (#1) regulating outlet and/or spillway gate.

Minimum gate openings will be observed at all times to avoid gate vibrations.

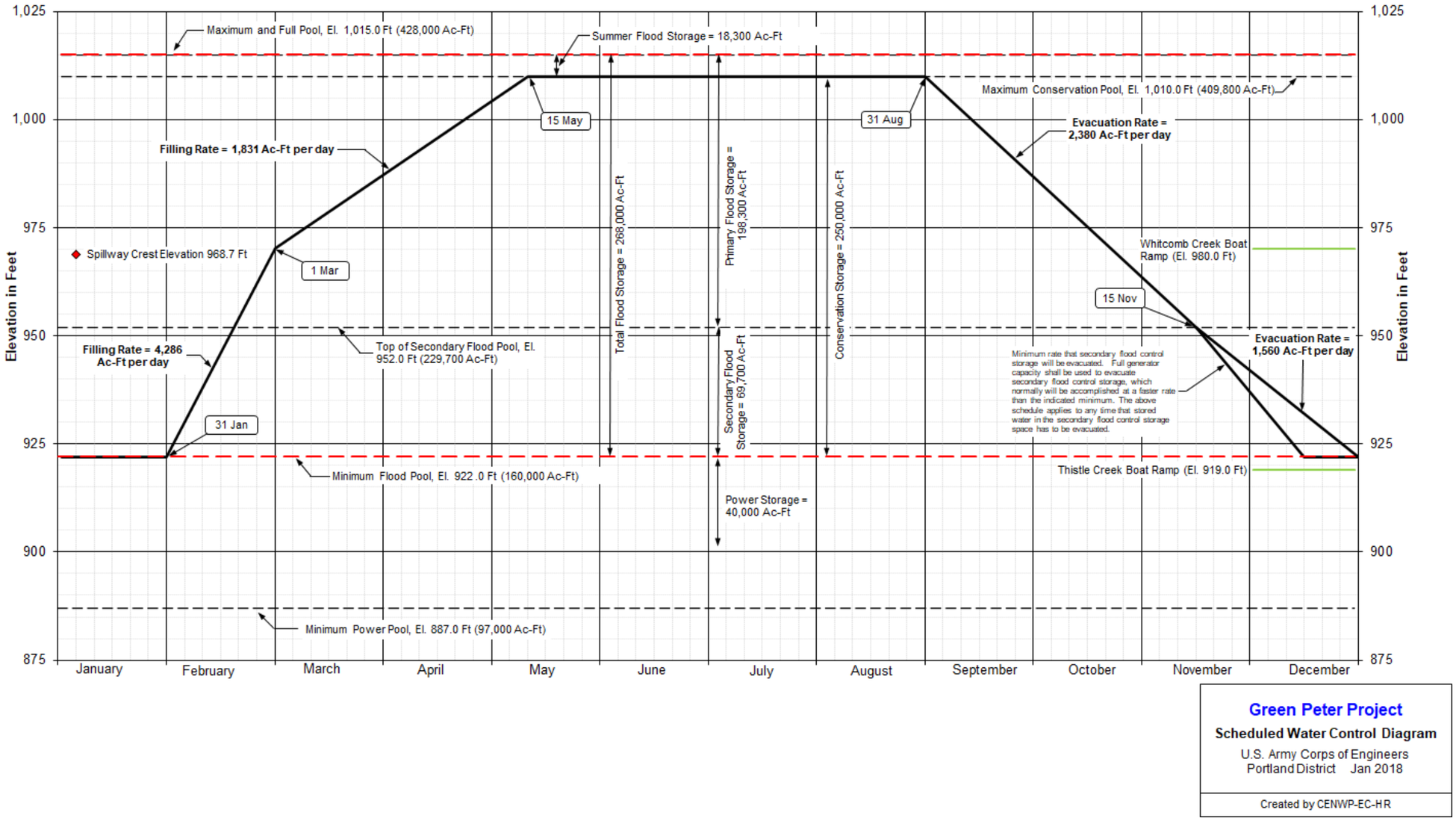
Hydropower Impacts

This operation will severely reduce power generation. Power generation will be limited starting in the summer as the drawdown begins and completely eliminated from approximately mid-October through mid-January once the reservoir is drafted below El. 887 ft.

Transmission Impacts

The Green Peter hydroelectric plant is located near the end of a transmission line and furnishes peak power to the local area. Green Peter project conditions are monitored from Foster Control Room and the Green Peter generating units and regulating outlets are remotely operated from Foster. BPA Transmission Operations does not have real time voltage indication on the line past Albany. For many years, one or both main units have been kept spinning continuously in either generation, synchronous condensing, or station service mode. When there is an interruption/loss of transmission line, Green Peter main units provide continuous uninterrupted power to the remote facility and power for the local area. In an islanding event, when the Green Peter Main units are tied to the transmission system the line will be maintained, and power is provided to the local area immediately. BPA is planning a project to make changes at Foster switchyard in fall, 2022 that would add stability to the line to Green Peter. Currently, in response to a fault at Foster, the breaker would take the line in the local region down, taking Green Peter off the line, depriving it of power from the line and preventing it from delivering power to the line. In addition, it adds risk that the Green Peter generators could be tripped, further jeopardizing the plant. This new breaker will be capable of keeping power on the line to Green Peter when it would otherwise be grounded out with the current in-service system.

Figure 2. Green Peter Reservoir Water Control Diagram



Additional Information

Injury and mortality of juvenile salmon downstream of Green Peter Dam

Juvenile Chinook salmon caught in the trap(s) downstream of Green Peter Dam will be examined for external injuries, parasites, gas bubble trauma and disease, and data will be recorded using methods of Romer et al. (2013) or equivalent based on protocols used in the Columbia River by the Pacific States Marine Fisheries Commission (Martinson et al. 2009). Mortalities in the trap and injuries of dead fish will be recorded and reported separately from live fish with injuries to reduce bias (e.g., capture rate in traps of live and dead fish is different). Conditions of fish such as fungus or parasites are generally considered independent of dam passage but may contribute to mortality and will be grouped separately from dam-related injuries. In particular, copepod infestation levels will be recorded as a potential variable contributing to mortality (beginning in 2023). For injuries associated with dam passage, they will be further delineated by their suspected cause: mechanical (e.g., descaling, body damage) or barotrauma (e.g., gas bubble symptoms).

Information on dam operations and changes in operations will be recorded for analysis of injuries/mortalities and potential contributing causes. Information would include reservoir elevation, gate openings, and timing and proportion of powerhouse and RO discharge. Mortalities in the trap would be recorded and expanded using results of trap efficiency test with dead fish (*see* 1.b.iii).

The potential additional effect of trapping and handling fish on injury and mortality will be evaluated by releasing a marked control group upstream of the trap, recording injury/morality of recaptures, and holding recaptures to estimate delayed mortality and to provide a correction factor for trap effects (compared to passage effects). These fish should be of a similar size to fish passing the dam. Injuries would be noted on control fish recaptured in the trap and the control group would then be held separately but in the same manner as fish that passed the dam. Hatchery fish used for trap efficiency tests and captured in the trap could be used for the control in holding mortality test (but not trap-caught fish that are used for trap efficiency tests).

Holding mortality tests

If the rotary screw trap(s) is placed where fish can be sampled from the two passage routes (powerhouse and RO), then fish captured for mortality tests would be separated based on the route. Alternatively, separate mortality tests would be conducted if juvenile salmon are caught during an operational period when the passage route can be identified. That is, if all fish caught in the trap occurred during powerhouse discharge, they would be held and recorded separately from fish caught during an exclusive RO discharge. Other information related to dam operations (gate opening, reservoir elevation level) would be recorded as a variable for analyzing holding mortality results.

Fish held for delayed mortality tests should include injured fish representing the range and degree of injuries as well as fish with no obvious external injuries. Information on injuries and diseases/parasites would be used to analyze contributing factors to mortality. Control groups released upstream of the trap(s) to evaluate effects of trapping and handling would be held separately but in the same manner as fish that passed the dam (*see* above).

References

Martinson, R., G. Kovalchuk, and D. Ballinger. 2009. Columbia River Basin Juvenile Fish Field Guide, Including Common Injuries, Diseases, Tags, and Invertebrates - 6th edition. Bonneville Power Administration & Pacific States Marine Fisheries Commission, The Dalles, pp 1-20.

Romer, J.D., F.R. Monzyk, R. Emig,, and T.A. Friesen, 2013, Juvenile salmonid outmigration monitoring at Willamette Valley Project reservoirs. Annual report, Cooperative Agreement: W9127N-10-2-0008, Oregon Department of Fish and Wildlife, Corvallis.

Sullivan, A.B., and S.A. Rounds, 2021, Modeling water temperature response to dam operations and water management in Green Peter and Foster Lakes and the South Santiam River, Oregon: U.S. Geological Survey Scientific Investigations Report 2020–5145, 27 p., https://doi.org/ 10.3133/ sir20205145.

ATTACHMENT 2

Cougar Regulating Outlet Modification Recommendation
2022-04-20

Background/Intent: On September 1, 2021, the U.S. District Court for the District of Oregon issued an Interim Injunction that directs the Corps to implement interim injunction measures intended to improve conditions for fish passage and water quality in the Willamette Valley Project (WVP) to avoid irreparable harm to Endangered Species Act (ESA) - listed salmonids during the interim period until the completion of the reinitiated consultation. These measures must be carried out "to the greatest extent practicable under existing hydrologic conditions and necessary flood control operations" while making "every effort to comply with the various water quality standards governing the WVP."

As required by the Order, the Expert Panel must determine whether structural improvements and/or modifications need to be made to Cougar Dam's regulating outlet (ROs) to ensure safer fish passage and reduce total dissolved gas (TDG) levels.

Cougar Dam is a rockfill structure with a powerhouse and concrete spillway with two Tainter gates, two slide gate ROs, two Francis turbine units, and a low-level outlet leading to a diversion tunnel. The spillway and diversion tunnel are not used for normal operations. A Water Temperature Control (WTC) tower was constructed adjoining the original intake tower and began operation in May 2005. The WTC is capable of selectively withdrawing water from different reservoir elevations to meet target outflow water temperatures, providing more natural conditions for salmonids in the South Fork and mainstem McKenzie rivers.

The ESA-listed species at Cougar Dam are UWR Chinook salmon and bull trout.

Discussion: Currently, juvenile fish passage through the dam's regulating outlet (RO) is the safest route of passage. Passing water through the RO at Cougar generates elevated TDG and may cause exceedance of the state water quality standard (110%). This generally occurs when RO discharges are in excess of 800 cfs, typically during involuntary flood risk reduction operations and/or powerhouse maintenance activities. Thus, avoiding the generation of excess TDG can at times limit the amount of RO discharge and thereby increase the need to store water or operate the powerhouse.

The turbine units at Cougar Dam are not known to produce increased levels of TDG but are known to be harmful to fish that pass through them. Therefore, for fish passage and survival benefits, discharges through the ROs are typically preferred, as reflected in the Expert Panel's implementation plans submitted for injunction measures 14 and 15(a). However, injury and mortality are associated with passage through the Cougar ROs as demonstrated in several studies and noted in fish captured in a rotary screw trap during 2021.

In December of 2009 and January of 2010, three separate studies examined fish mortality and passage conditions for both the turbines and ROs. For Cougar, with the RO operating at gate openings of 1.5 ft and 3.7 ft, survival rates were 84.6% (SE = 2.9%) and 88.3% (SE = 2.5%), respectively, for HI-Z (balloon tags) tagged fish with a relative detection rate of 85% and 104% for PIT (Passive Integrated Transponder) tagged fish to Leaburg dam (Monzyk 2010a). In contrast, direct survival 48 h after passage was 36–42 percent through the powerhouse (Normandeau Associates, Inc.). Beeman et al. (2014, Table 7) in

another study of RO passage estimated relative reach-specific survival probabilities below the McKenzie-Willamette confluence ranged from 0.46 to 0.74.

Duncan (2011) used sensor fish[1] to test the effects of RO passage at two gate openings (1.5 ft and 3.7 ft). About 97% of the sensor fish had a significant collision or shear event (acceleration magnitude greater than 95 g) during RO passage, with nearly 86% having multiple significant events; all sensor fish passing with the 1.5 ft gate opening had multiple events. The most severe events were primarily collisions within the RO chute, representing 78% of the total events with a 1.5 ft gate opening and 63% of the total events at the 3.7 ft opening (Figure 1). Injuries of juvenile Chinook salmon caught in the RO channel with a rotary screw trap (RST) differed between 2012 and 2021 (Figure 2). In 2021 when the reservoir was drawn down, the incidence of barotrauma injuries was substantially lower (11%) than in 2012 (58%). Among the mechanical-type injuries assumed to be attributed to dam passage, over half was from severe descaling and was higher in 2021 (66%) than in 2012 (56%; Figure 2). Roughness of the RO chute is thought to be a key factor in the injury of fish during RO passage (personal communication, Jeff Ziller, ODFW).

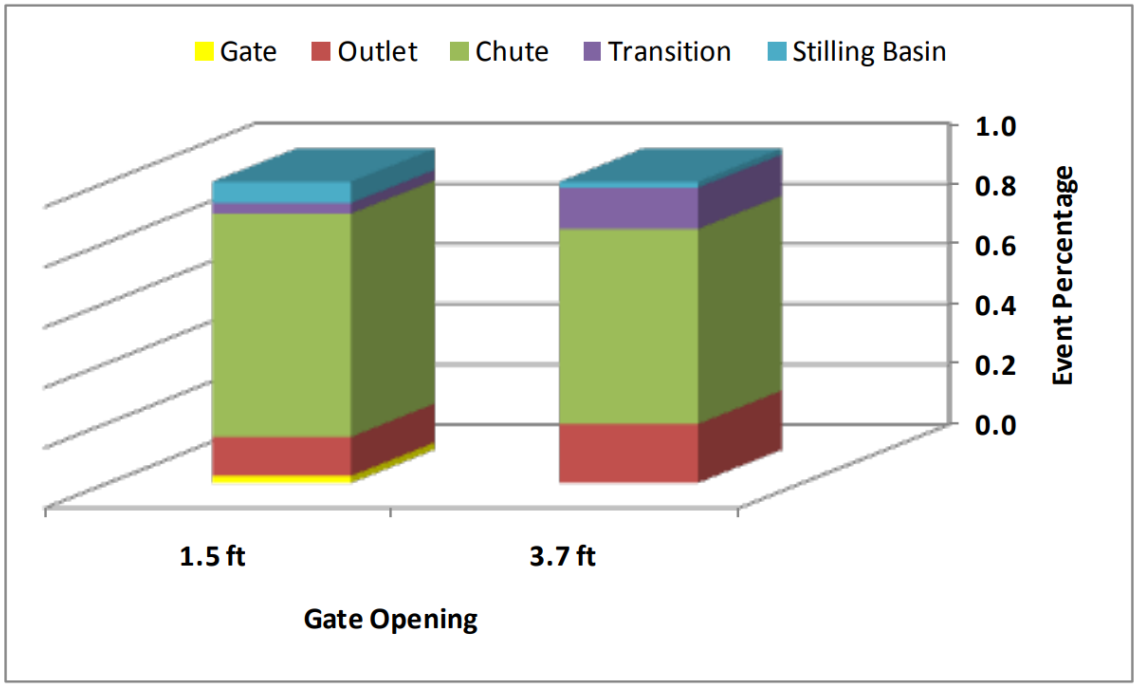


Figure 1. Frequency of occurrence by location of the most significant events (collision and shear) on sensor fish in the RO passage route at two gate openings, December 2009.

[1] A sensor fish is a small, plastic tubular device containing sensors. It is designed to record information such as the physical stresses that a fish experiences while navigating currents from dam turbines.

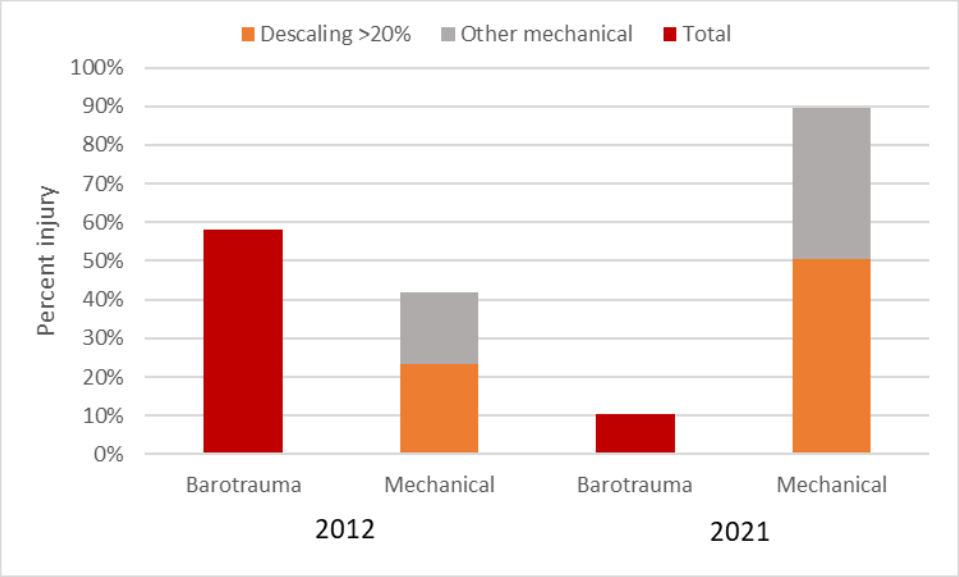


Figure 2. Percentage of injury type attributed to dam passage for juvenile Chinook salmon captured in the RO channel trap, fall and early winter 2012 and 2021. Data in 2021 includes injuries of fish with copepod infestation as the primary condition that also had other injuries. Data in 2012 *from* Romer et al. 2013.

In September 2021, Corps contractors conducted a post-collection holding study during implementation of injunction measure 14 wherein the first 50 live juvenile Chinook captured per week were held for 24 hours and subsequently assessed before release to document mortality. Priority for the tests was fish collected in the RO channel trap. This resulted in ten 24-hour post-capture holding 'trials' between the weeks of 19 Sept 2021 and 21 November 2021 with a total of 498 juvenile Chinook salmon captured below Cougar Dam (Table 2). The total mortality rate was 22% (111 mortalities), with weekly mortality rates ranging from 4–36% during this period. On average, mortalities and survivors were of similar size (138 mm vs 135 mm) and presented with a similar number of adverse conditions (e.g., descaling, copepods infestations) per individual (1.5 vs 1.4). However, mortalities were more likely to have descaling over more than 20% of their body, more likely to be infested with copepods, and had more severe copepod infections when compared to fish that survived the 24-hour holding period. Gate openings varied during this time and could have affected the survival as well.

Table 2. Results of the 24-hour post-capture holding trial at Cougar Dam for the weeks of 19 September 2021 to 30 November 2021. The first 50 live juvenile Chinook per week were held for purposes of these holding trials with priority on utilizing fish from the

Week	Subjects	Mortalities	Mort Rate	Mean Subject Length (mm)	Mean Mort Length (mm)	Mean Subject Injuries	Mean Mort Injuries	Mean Subject Copepods	Mean Mort Copepods
9/19/2021	13	2	0.15	180.2	141.0	1.4	2.0	12.1	13.0
9/26/2021	47	13	0.28	149.1	150.8	0.7	1.2	8.3	10.2
10/3/2021	88	32	0.36	146.9	142.6	0.9	1.1	8.5	8.9
10/10/2021	50	11	0.22	147.8	133.0	0.8	1.0	9.9	7.7
10/17/2021	50	14	0.28	139.6	153.6	0.9	1.1	8.9	12.3
10/24/2021	50	16	0.32	130.4	133.1	1.2	1.3	5.7	6.9
10/31/2021	50	12	0.24	124.2	116.0	1.8	2.4	4.0	4.5
11/7/2021	50	6	0.12	121.3	121.5	2.6	3.0	4.5	7.5
11/14/2021	50	2	0.04	113.3	134.0	2.2	2.5	3.4	6.0
11/21/2021	50	3	0.06	122.0	123.7	2.2	4.7	4.5	3.7

These data and existing constraints present several issues for the use of the RO system to safely pass juvenile salmon.

1. Passage through the RO system can kill or injure fish, primarily in the steep chute channel between the dam and the RO stilling basin.
2. RO operation is constrained by the production of excess TDG at discharge rates in excess of 800 cfs, leading to a need to operate the powerhouse at times, which is unsafe for fish passage purposes. The limits on discharge (due to TDG) also constrain gate opening size. The smaller the gate opening, the more likely fish will strike the gate upon existing the RO channel.
3. Because the adult trap facility is dependent on powerhouse flows for attraction, daytime powerhouse operation is preferred during trap operations. The facility is typically operated from mid-March through mid-October, however based on previous returns to the facility, mostly hatchery fish are collected at the trap beyond September 01; and less than 1% of the total run is captured at the trap after October 1. This indicates that more operational flexibility and preference of the RO over the powerhouse could be considered in the fall.

Recommendation: Based on the information provided above, which indicates the RO chute is a likely source of injury, the first measure aimed at improving RO passage survival will be improving chute performance by providing a fish-friendly coating, designed to reduce injury and provide a survival benefit. The Corps has determined that it is not feasible to recoat the Cougar RO chute in summer 2022 prior to the implementation of Injunction Measure 14 in September 2022 because of the time required for: an inspection of the RO chute to determine recoating needs (e.g., grinding); preparation of contract plans and specifications; solicitation and award of a contract for the recoating work; contract material procurement and mobilization; and actual construction by the contractor. Therefore, the Expert Panel recommends the Corps recoat the Cougar RO chute no later than September 1, 2023. The Corps will provide an update on its progress to develop its plan for recoating the RO chute in Federal Defendants' status report due on August 28, 2022 and will identify its plan for recoating the RO chute, including the timeline for performance of the work (to be completed no later than September 1, 2023), in Federal Defendants' status report due on February 28, 2023. Because of requirements for RO prioritization in

the fall and spring under Injunction Measures 14 and 15a, the inspection and construction work for the recoating will likely need to occur during summer 2022 and 2023, respectively.

Although sensor-fish data suggest that the chute is a likely cause of fish injury, further evaluation of the causes and possible remedies for fish injury and mortality when passing through the RO is warranted. For this reason, the Expert Panel recommends that the Corps have a technical Product Delivery Team[2] (PDT) conduct a full review of available data on potential sources of injury and mortality through the RO passage route to 1) identify the known sources of injury and mortality from the RO system components (RO gates, chute, and stilling basin) and operations (e.g. head, gate openings), and 2) identify critical information gaps and identify studies to address gaps. The Expert Panel recommends that the PDT, based on this information, identify measures to improve/modify the Cougar Dam RO passage route to provide safer fish passage and to increase the allowable rate of discharge without generating excess TDG. The design goal is to provide 95% juvenile passage survival through the RO system and increasing the allowable RO discharge rate to 1,500 cfs without exceeding 110% TDG downstream from the RO channel stilling basin.[3] In identifying alternatives, the PDT should consider both relatively simple structural solutions, such as those that could be designed and constructed in less than 5 years, if any, and more complex structural improvements with a longer design and construction timeline. The PDT will develop an estimated cost and schedule associated with design and construction of each alternative carried forward. In 2022, the PDT will prioritize the design work to recoat the RO chute no later than September 1, 2023, therefore, the PDT should provide the estimated costs and schedules for the other alternatives to provide safer fish passage and reduce the generation of excess TDG by June 30, 2023. The Corps will provide updates on the progress of the PDT in Federal Defendants' biannual status reports.

In the interim, the Corps and NMFS will continue to implement and optimize Injunction Measures 14 and 15(a) at Cougar Dam as additional information about the biological response of spring Chinook salmon and bull trout to varying operational parameters (RO gate openings, reservoir drawdown rates, timing, elevations, etc.) becomes available through ongoing research, monitoring, and evaluation.

Baseline monitoring conducted under Injunction Measure 14 and 15a, as described in the Willamette Project Interim Injunction Measures Research, Monitoring, and Evaluation Plan, will provide an estimate of the effectiveness of modifications and/or improvements to the RO passage route in providing safe passage for juvenile Chinook salmon. Specifically, data collected on injury and mortality of juvenile salmon captured in a screw trap in the RO channel and held for mortality tests will allow comparisons to previous years. Additional evaluation of specific RO modifications will be developed as appropriate.

References:

Beeman, J.W., Evans, S.D., Haner, P.V., Hansel, H.C., Hansen, A.C., Smith, C.D., and Sprando, J.M., 2014, Passage and survival probabilities of juvenile Chinook salmon at Cougar Dam, Oregon, 2012: U.S. Geological Survey Open-File Report 2014-1038, 64 p., *http://dx.doi.org/10.3133/ofr20141038/*.

[2] The PDT will include biologists to lead the review of available fish passage information, identify information gaps and potential studies to address gaps, and direct the PDT toward appropriate solutions to achieve biological benefits.

[3] Achieving these numerical goals may prove infeasible and may be modified as needed to provide feasibility with the goal of improving RO passage survival and TDG performance to the extent possible.

Duncan, J.T. 2011. Characterization of fish passage conditions through a Francis turbine and regulating outlet at Cougar Dam, Oregon, using sensor fish, 2009–2010. Final Report PNNL-20408, Pacific Northwest National Laboratory, Richland, Washington, 172 p.

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Romer, J.D., Monzyk, F.R., Emig, R., and Friesen, T.A., 2013, Juvenile salmonid outmigration monitoring at Willamette Valley Project reservoirs. Annual report, Cooperative Agreement: W9127N-10-2-0008, Oregon Department of Fish and Wildlife, Corvallis.